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Kurumizawa

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(54) **LOCK DEVICE**

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H01R 13/703 (2006.01)

(52) **U.S. Cl.**
CPC ***H01R 13/6397*** (2013.01); ***H01R 13/7031*** (2013.01); *H01R 2201/26* (2013.01)

(58) **Field of Classification Search**
CPC H01R 13/6397; H01R 13/6275; H01R 13/62933; H01R 13/629; H01R 13/6272; H01R 2201/26; G07C 9/0096; E05B 47/0012
See application file for complete search history.

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(57) **ABSTRACT**

A lock device locks a locking subject and includes a lock member moved between a lock position for locking the locking subject and an unlock position for unlocking the locking subject. A first urging member urges the lock member to the lock position. A switching member moves between a first position where the switch member fixes the lock member at the lock position and a second position where the switch member permits the lock member to unlock the locking subject. A first actuator drives the switching member. A position detector is arranged in a power supply line connected to the first actuator. The position detector detects whether the lock member has been moved from the unlock position to the lock position subject and permits the supply of power to the first actuator when detecting the movement.

7 Claims, 7 Drawing Sheets

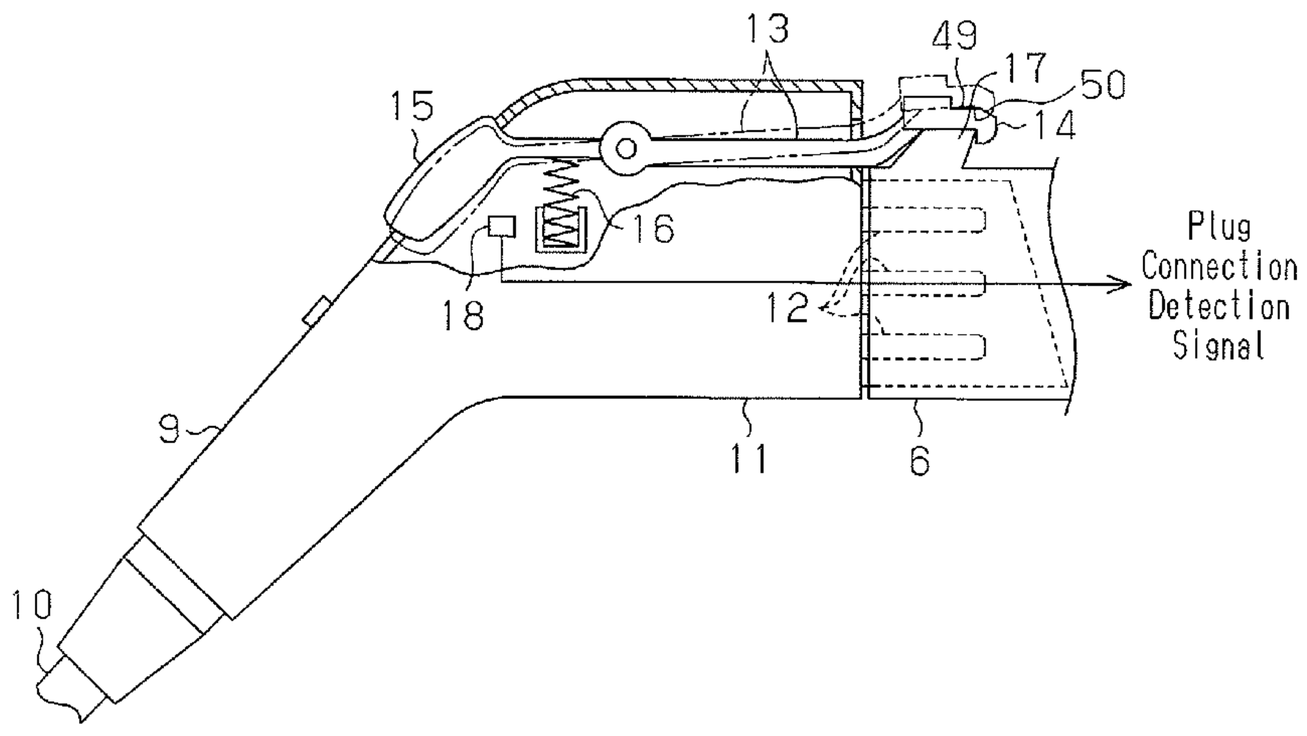
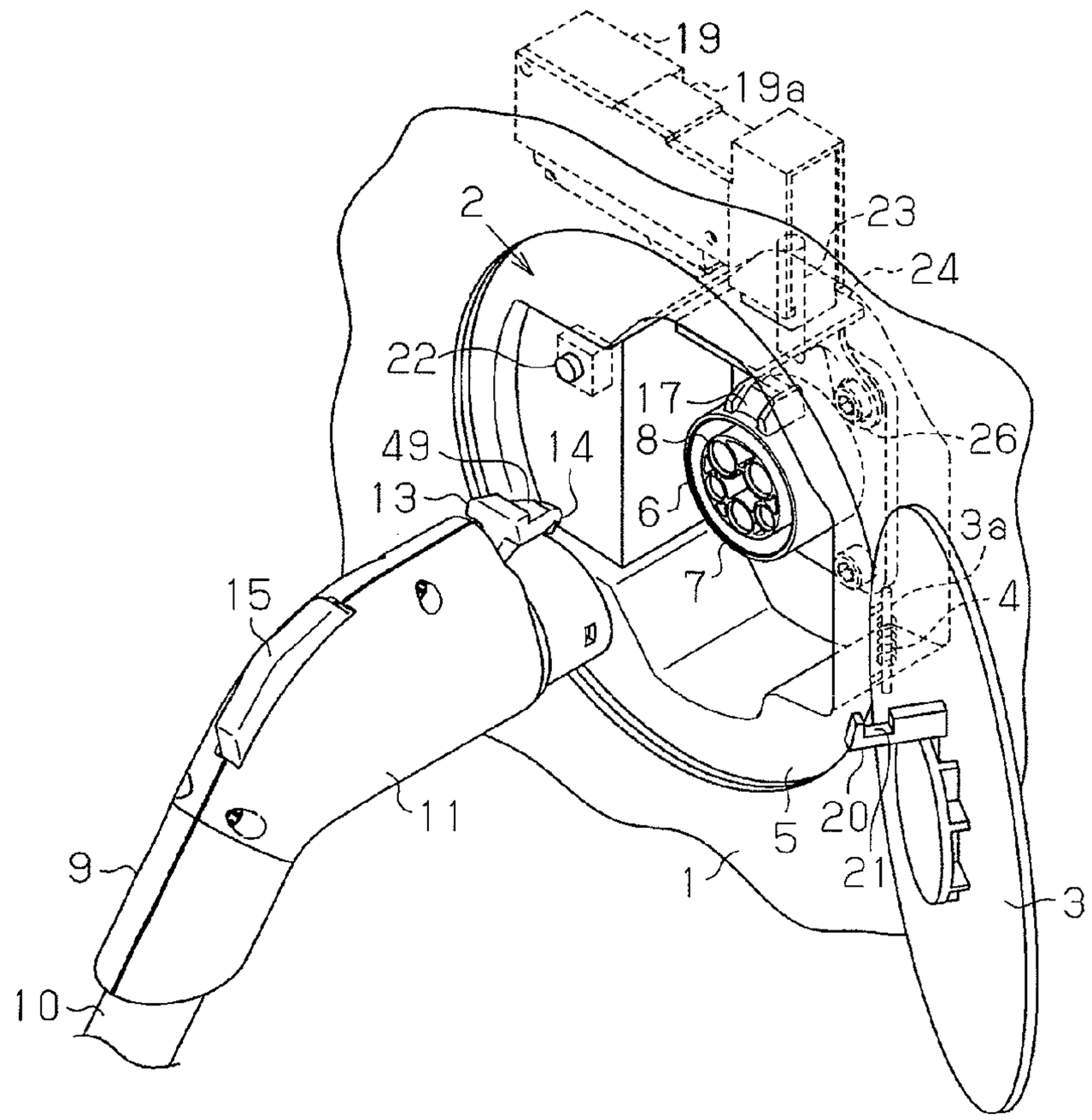


Fig.1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24
22
17
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26
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6
3a
7
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3
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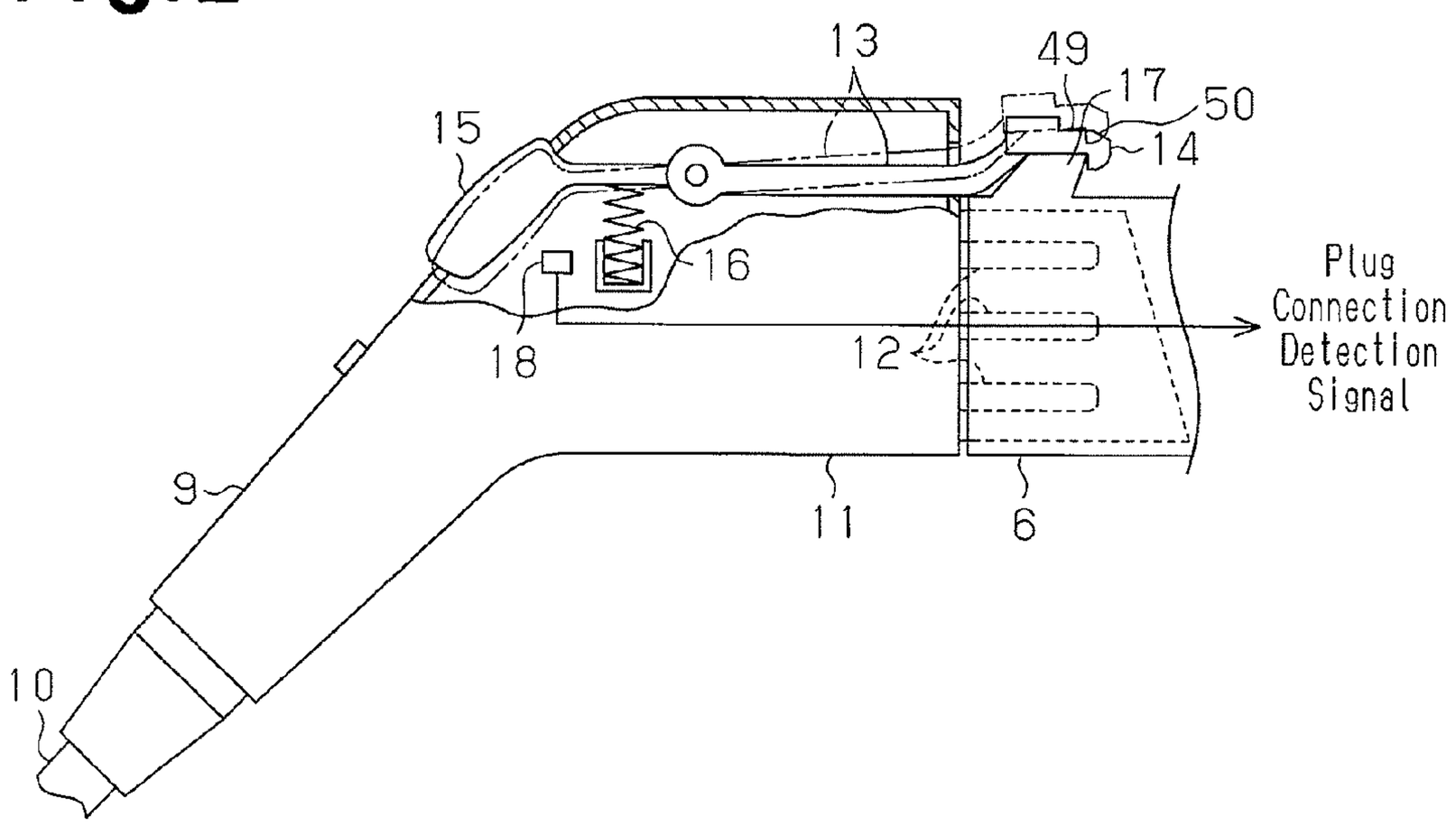
Fig.2


13
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Plug
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Detection
Signal
9
11
6
10

Fig.3

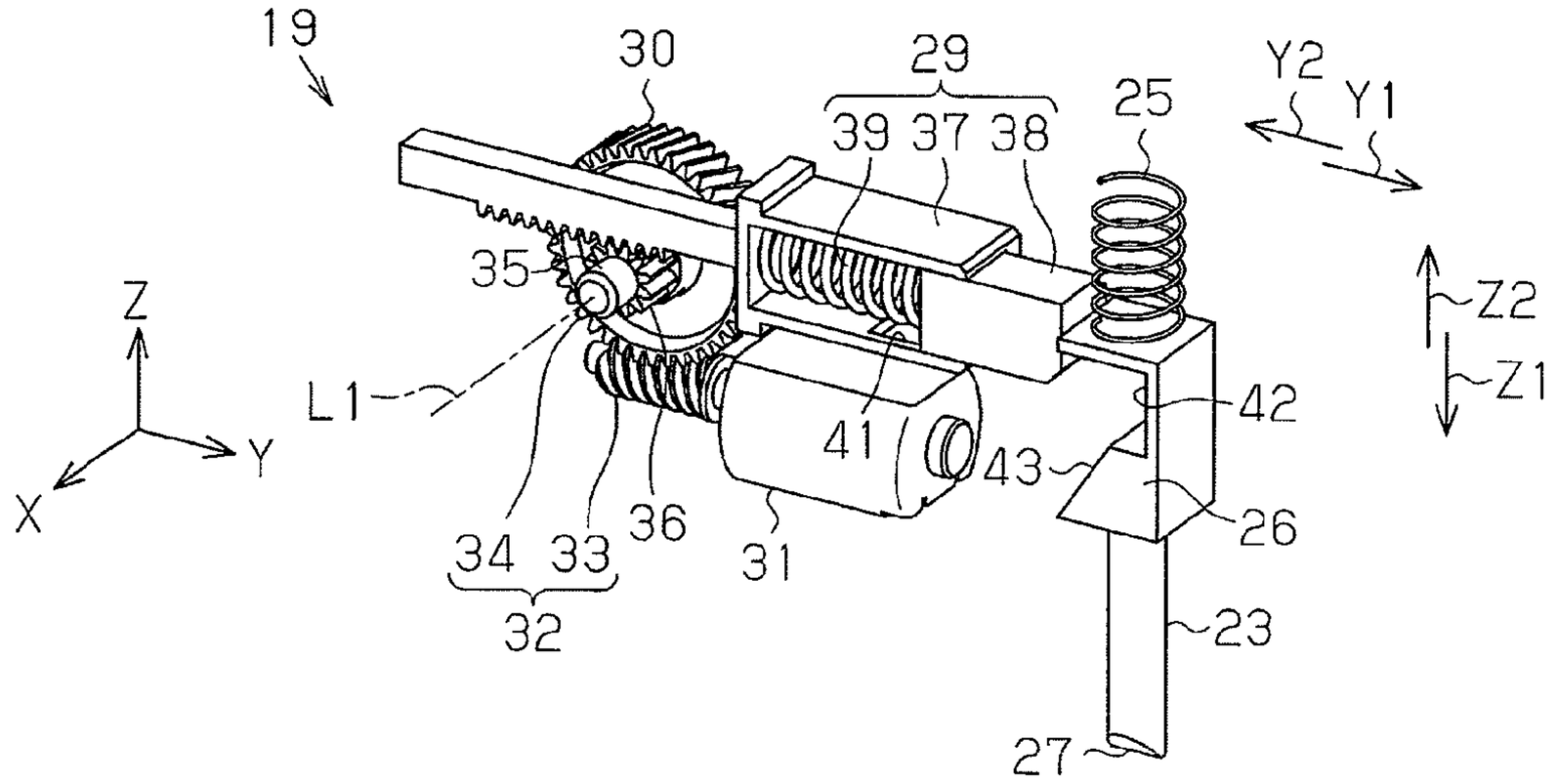


Fig.4A

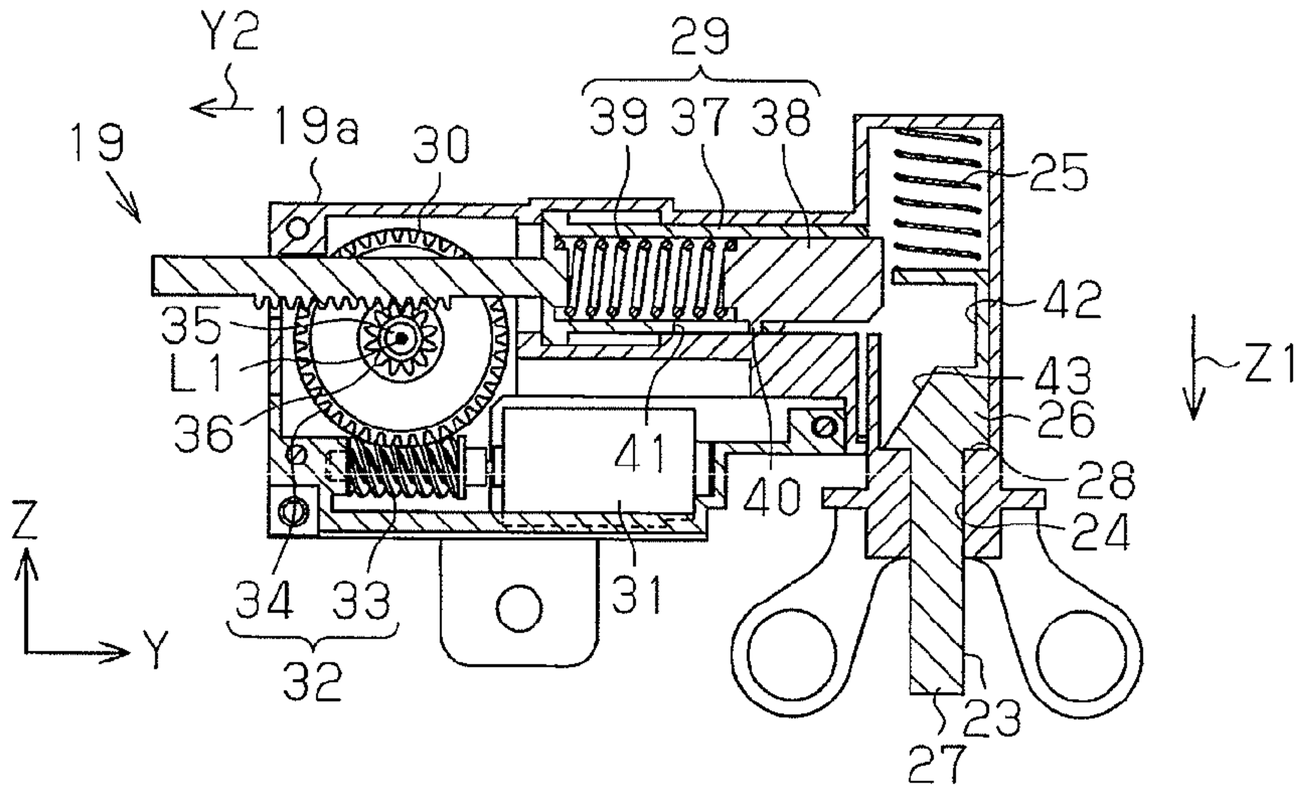


Fig.4B

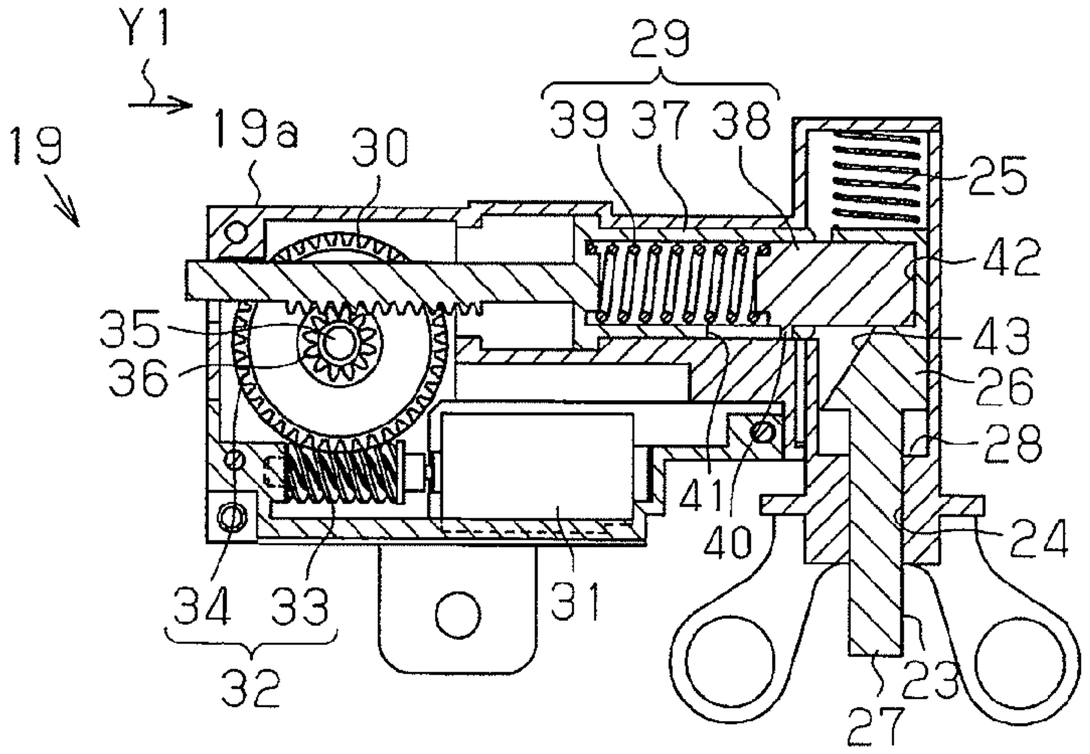


Fig.5

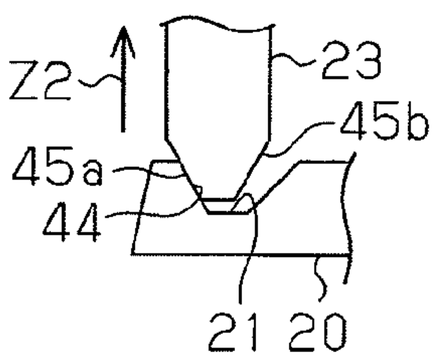
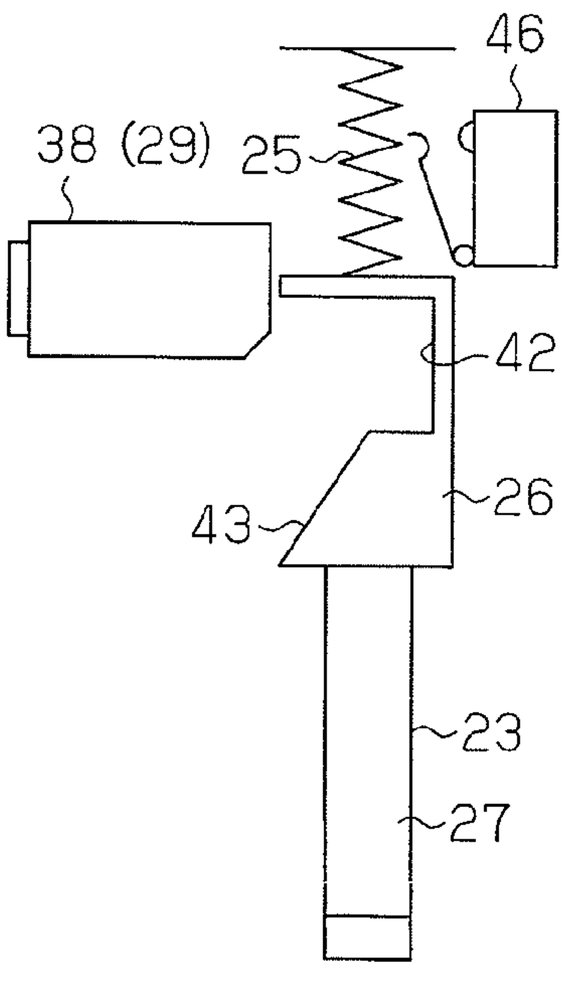


Fig.6



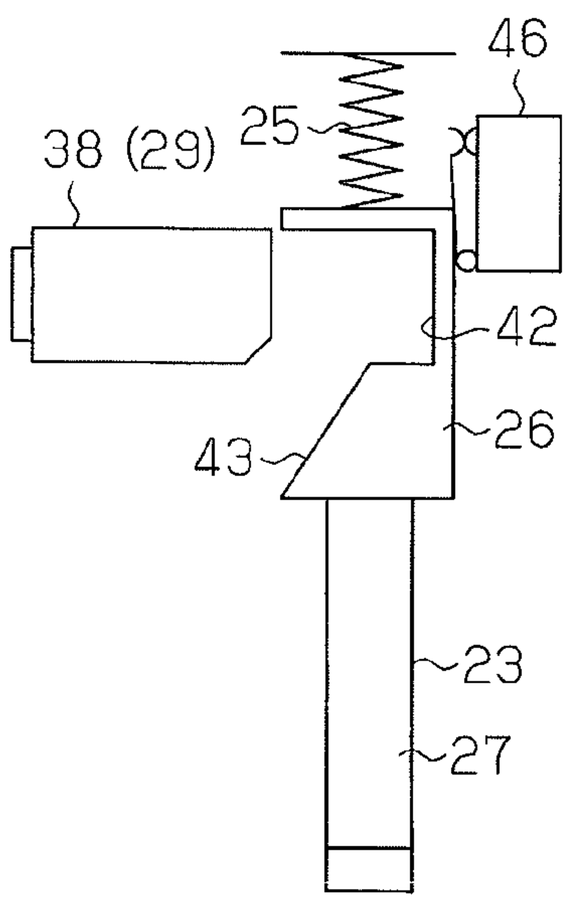


Fig.7

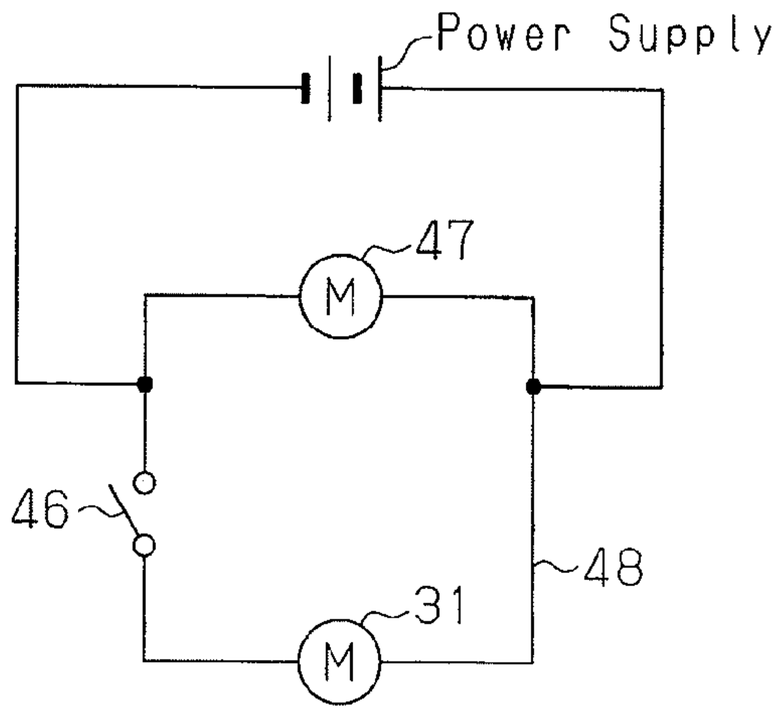


Fig.8

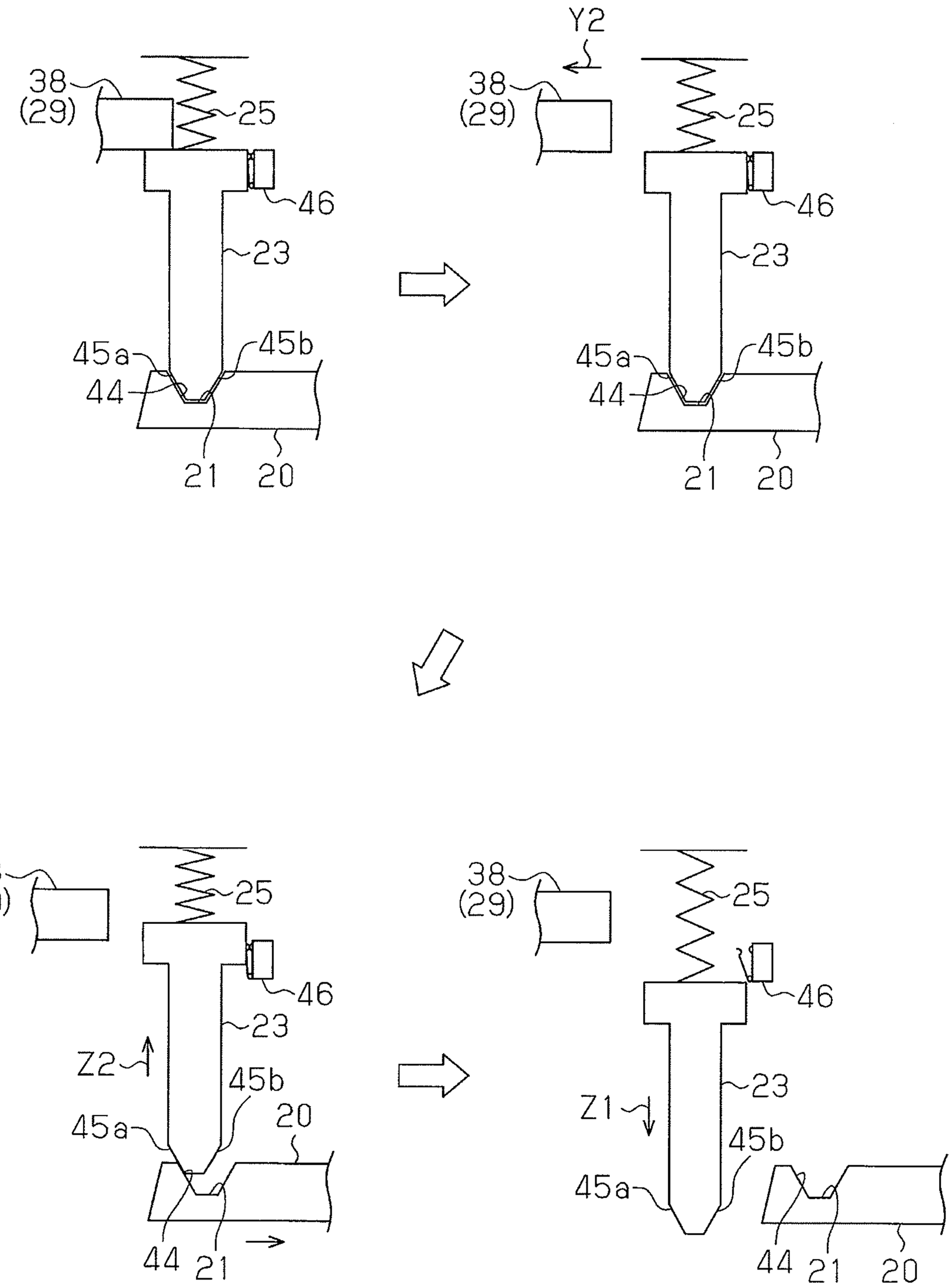


Fig.9

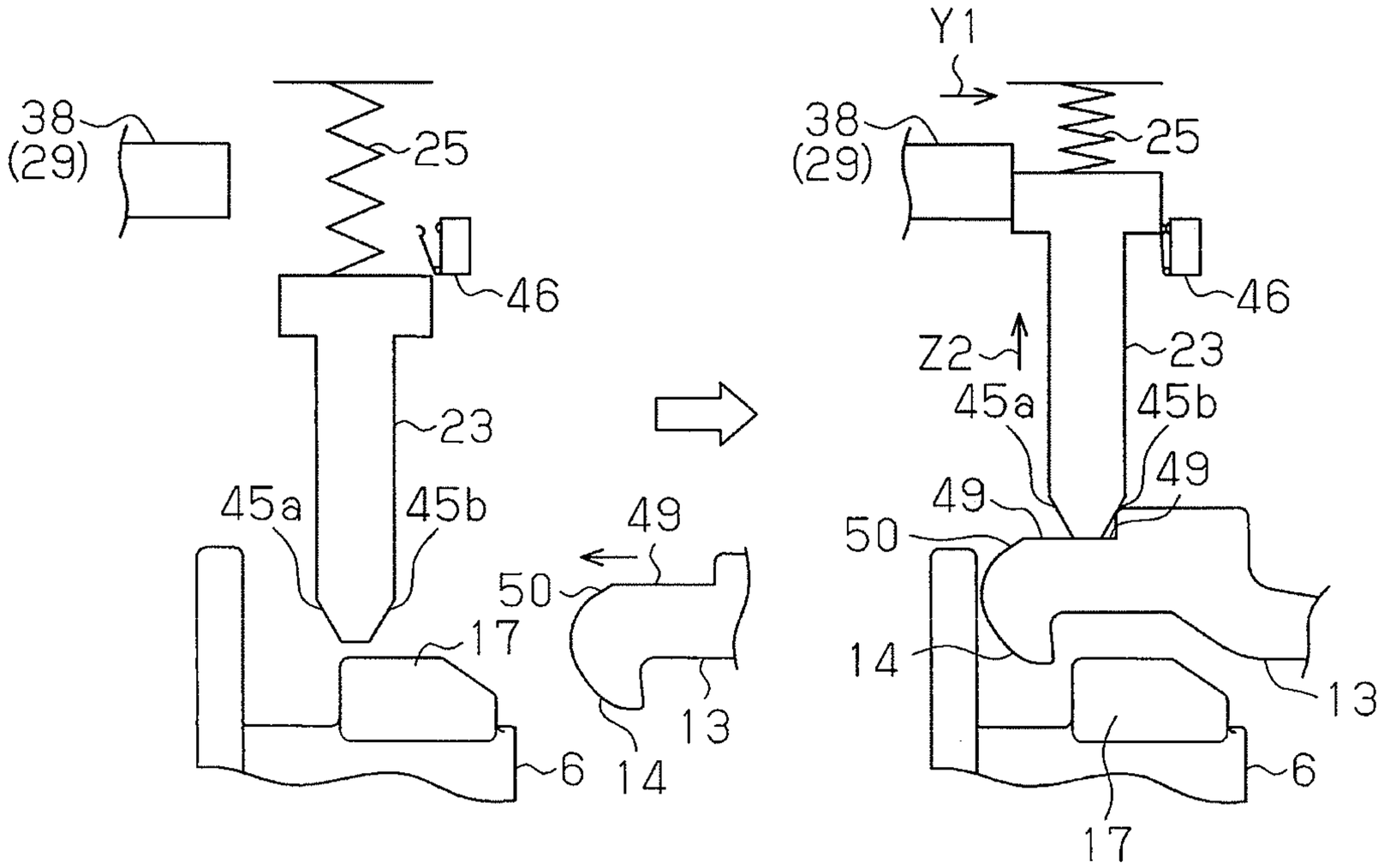


Fig.10

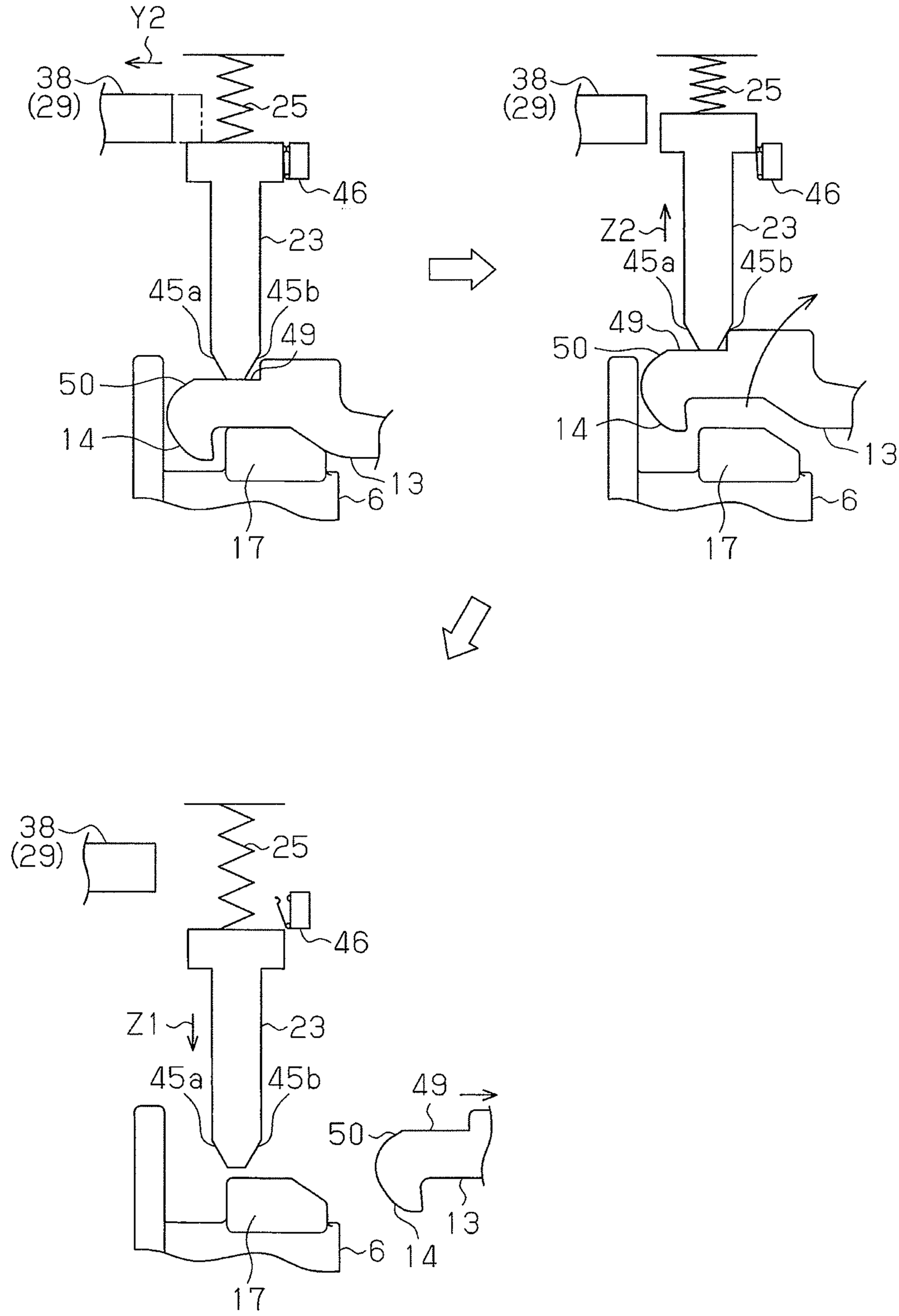
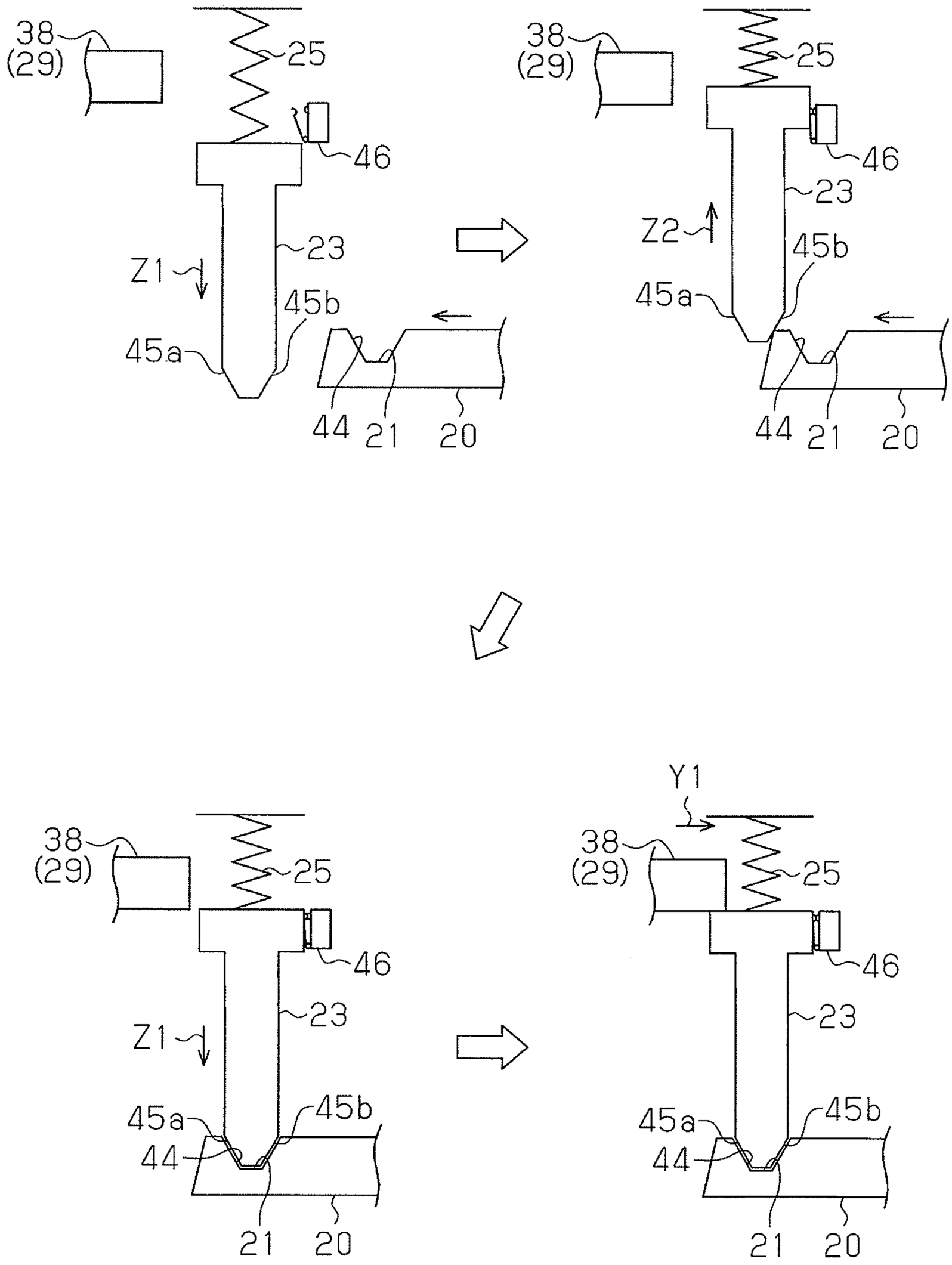


Fig.11



LOCK DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based upon and claims the benefit of priority from prior Japanese Patent Application No. 2012-272496, filed on Dec. 13, 2012, the entire contents of which are incorporated herein by reference.

BACKGROUND ART

The present invention relates to a lock device for locking and unlocking a locking subject related to a power port.

Vehicles that emit less carbon dioxide, such as plugin hybrid vehicles and electric vehicles, are environment-friendly and have become popular. Such a vehicle is powered by a battery. When the battery drains after driving the vehicle over a long distance, the battery is recharged. The body of the vehicle is provided with a power port used to charge the battery. A charge cable of a charging facility is connected to the power port to supply power from the charging facility and charge the battery. The battery charging takes a long time. Thus, a charge cable lock device may be used to lock the charge cable to the vehicle body and prevent theft of the charge cable. Japanese Laid-Open Patent Publication No. 2009-081917 describes an example of such a charge cable lock device.

The charge cable lock device may lock and unlock the charge cable in cooperation with the locking and unlocking of the vehicle doors. However, when the charge cable locking is performed in cooperation with the door locking, the charge cable lock device may function in cooperation with the locking and unlocking of the vehicle doors even when the charge cable is not connected to the inlet. This may shorten the life of the lock device.

SUMMARY OF THE INVENTION

One aspect of the present invention is a lock device for locking a locking subject. The lock device includes a lock member that moves between a lock position where the lock member locks the locking subject and an unlock position where the lock member unlocks the locking subject. A first urging member constantly urges the lock member to the lock position. A switching member moves between a first position where the switch member fixes the lock member at the lock position and a second position where the switch member permits the lock member to unlock the locking subject. A first actuator drives the switching member. A position detector is arranged in a power supply line connected to the first actuator. The position detector detects whether or not the lock member has been moved from the unlock position to the lock position by the locking subject and permits power to be supplied to the first actuator when detecting the movement.

Other aspects and advantages of the present invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

FIG. **1** is a perspective view showing a power port in one embodiment;

FIG. **2** is a diagram showing the connection of a charge cable to an inlet;

FIG. **3** is a perspective view showing the internal structure of a lock device;

FIG. **4**A is a cross-sectional view showing the lock device in an unlock state;

FIG. **4**B is a cross-sectional view showing the lock device in a lock state;

FIG. **5** is a side view of a striker and a lock pin;

FIG. **6** is a schematic diagram showing a constantly locking urging mechanism;

FIG. **7** is a motor circuit diagram of the lock device;

FIG. **8** is a schematic diagram illustrating a lid unlocking operation;

FIG. **9** is a schematic diagram illustrating a charge cable locking operation;

FIG. **10** is a schematic diagram illustrating a charge cable unlocking operation;

FIG. **11** is a schematic diagram illustrating a lid locking operation.

DETAILED DESCRIPTION OF THE INVENTION

A lock device according to one embodiment of the present invention will now be described with reference to FIGS. **1** to **11**.

Outline of Charge System

Referring to FIG. **1**, a vehicle such as a plugin hybrid vehicle includes a charge system that allows for a battery (not shown) of the vehicle to be charged by an external power supply installed in a household, charging station, or the like. The body **1** of the vehicle has a side wall including a power port **2**. A lid **3** opens and closes the power port **2**. The lid **3** is pivotal about a shaft **3***a*, which extends in the vertical direction. An urging member **4**, such as a torsion spring, is arranged on the shaft **3***a* to urge the lid to an open position. An inlet **6**, which serves as a power receiving connector, is arranged at the middle of a lid box **5** in the power port **2**. The inlet **6** includes a cylindrical inlet case **7**, a terminal portion **8** arranged in the inlet case **7**, and a catch **17** arranged on the inlet case **7**. The lid **3** corresponds to a locking subject.

Referring to FIG. **2**, a charge cable **9** extending from an external power supply is connectable to the inlet **6**. The charge cable **9** includes a cable portion **10** and a power plug **11**, which is arranged on the distal end of the cable portion **10** and serves as a power supplying connector. A terminal portion **12** is arranged on the distal end of the power plug **11** in correspondence with the terminal portion **8** of the inlet **6**. A lock arm **13** is pivotally coupled to the power plug **11** to hold the power plug **11** on the inlet **6**. The lock arm **13** is pivoted between a hold position, where the power plug **11** is held on the inlet **6**, and a release position, where the power plug **11** is released from the inlet **6**. The lock arm **13** includes a hook **14**, which is arranged on the distal end of the lock arm **13**, and an arm operation portion **15**, which is arranged on the basal end of the lock arm **13**. The hook **14** and the arm operation portion **15** are exposed to the exterior. An urging member **16** is arranged on the lock arm **13** near the arm operation portion **15** to constantly urge the lock arm **13** to a lock position. The charge cable **9** corresponds to a locking subject.

When the power plug **11** is connected to the inlet **6**, the power plug **11** is fitted straight to the inlet **6**. Then, the hook **14** comes into contact with a sloped surface of the catch **17** on the inlet cases **7**. This lifts the hook **14**. After the hook **14** moves over the sloped surface, the power plug **11** is fully

fitted to the inlet **6**. Then, the urging force of the urging member **16** pivots the lock arm **13** to a hold position. As a result, the hook **14** is hooked to the catch **17**, and the power plug **11** is held by the inlet **6**.

A plug connection detector **18** is arranged in the power plug **11** to detect connection of the charge cable **9** to the inlet **6**. When the charge cable **9** is connected to the inlet **6** and the hook **14** is hooked to the catch **17**, the plug connection detector **18** detects that the lock arm **13** is located at the hold position. When the plug connection detector **18** detects that the lock arm **13** is located at the hold position, the plug connection detector **18** provides a plug connection detection signal, which indicates that the power plug **11** is connected to the inlet **6**, to the vehicle body **1** via the terminal portions **8** and **12**.

Structure of Lock Device

As shown in FIGS. **1** and **3**, the power port **2** includes a lock device **19** capable of locking both of the lid **3** and the charge cable **9**. In other words, the lock device **19** of the present example is of an integrated type in which a lid lock device and a charge cable lock device share the same actuator. A striker **20** projects from a rear surface of the lid **3**. The lock device **19** engages the striker **20** when locking the lid **3**. An engagement groove **21** having a predetermined depth is formed in the distal end of the striker **20**. A trigger switch **22** is arranged in the power port **2**. The trigger switch **22** may be of a push type. The trigger switch **22** is capable of detecting, for example, the opening and closing of the lid **3** or further inward pushing of the lid **3** from a closed position.

As shown in FIGS. **4**A and **4**B, the lock device **19** includes a housing **19***a* that accommodates a lock pin **23**, which is engageable with the lid **3** and the power plug **11**. The lock pin **23** is movable back and forth in its longitudinal direction (Z axis direction in FIG. **4**A). For example, the housing **19***a* includes a pin accommodation portion **24**. A lock pin **23** is movably arranged in the pin accommodation portion **24**. A step is formed in a longitudinally middle part of the pin accommodation portion **24**. An urging member **25** is arranged between an inner wall of the housing **19***a* and the lock pin **23** to constantly urge the lock pin **23** in a lock direction (direction of arrow Z**1** in FIG. **4**A). In this manner, the lock device **19** of the present example is a constantly locking urging mechanism. In the lock device **19** of the present example, the urging member **25** constantly urges the lock pin **23** so that the lock pin **23** locks either one of the lid **3** and the power plug **11**. For example, a coil spring is used as the urging member **25**. The lock pin **23** corresponds to a lock member.

The lock pin **23** is generally pin-shaped and includes a head **26** having a large diameter and a shaft **27** having a smaller diameter than the head **26**. The head **26** of the lock pin **23** is caught and held on a step **28** in the pin accommodation portion **24**.

The lock device **19** includes a link **29** that permit and prohibits movement of the lock pin **23**. The link **29** is movable back and forth in its longitudinal direction (Y axis direction in FIG. **4**A). More specifically, the link **29** moves between a first position where the link **29** fixes the lock pin **23** at a lock position, and a second position where the link **29** permits the lock pin **23** to unlock the locking subjects **3** and **9**. A wheel **30** connects the link **29** to a lock motor **31**. A worm gear **32** couples a motor shaft of the lock motor **31** to the wheel **30**. The worm gear **32** includes a worm **33**, which is formed on the motor shaft, and a worm wheel **34**, which is formed by the wheel **30**. The link **29** corresponds to a switching member, and the lock motor **31** corresponds to an actuator (first actuator).

A shaft **35** including a pinion **36** extends from the wheel **30**. The pinion **36** rotates integrally and coaxially with the wheel **30**. The pinion **36** is coupled to the link **29**. The link **29** includes a rack **37**, which is engaged with the pinion **36**, an engagement pin **38**, which is fitted to the rack **37**, and an urging member **39**, which is arranged between the rack **37** and the engagement pin **38**. The urging member **39** may be, for example, a coil spring. A structure including, for example, a projection **40** and an elongated hole **41** couple the rack **37** and the engagement pin **38**. The drive force generated by the lock motor **31** rotates the wheel **30** about the axis L**1** of the cylindrical shaft **35**. The rotation of the wheel **30** moves the link **29** in a direction (Y axis direction in FIG. **4**A) that is perpendicular to the moving direction of the lock pin **23** (Z axis direction in FIG. **4**A). The rack **37** corresponds to a support member, and the engagement pin **38** corresponds to an engagement member.

The head **26** of the lock pin **23** includes a groove **42** that can receive the engagement pin **38**. When the engagement pin **38** is engaged with the groove **42**, movement of the lock pin **23** is disabled in the vertical direction (Z direction in FIG. **4**A). Further, the side surface of the head **26** defines a guide slope **43** that guides the engagement pin **38**, which is forced to the lock side (toward the lock pin **23**), into the groove **42**. Thus, when the engagement pin **38** and the groove **42** are not correctly engaged and the engagement pin **38** is in contact with the guide slope **43**, the urging force of the urging member **39** pushes the engagement pin **38** against the guide slope **43**, which guides the engagement pin **38** into the groove **42**. The groove **42** corresponds to an engaged portion.

As shown in FIG. **4**A, when the lock motor **31** generates rotation in one direction and moves the link **29** in an unlock direction (direction of arrow Y**2** in FIG. **4**A facing away from lock pin **23**), the engagement pin **38** is separated from the groove **42** of the lock pin **23**. This permits movement of the lock pin **23** and allows for the lock pin **23** to move back and forth between the lock position and the unlock position while receiving urging force in the lock direction. Under this situation, the lock device **19** is in an unlock state and permits movement of the lock pin **23**.

As shown in FIG. **4**B, when the lock motor **31** generates rotation in the other direction and moves the link **29** in a lock direction (direction of arrow Y**1** in FIG. **4**B facing toward lock pin **23**), the engagement pin **38** is engaged with the groove **42** of the lock pin **23**. This prohibits movement of the lock pin **23** so that the lock pin **23** cannot move along its longitudinal direction. Under this situation, the lock device **19** is in a lock state and prohibits movement of the lock pin **23**.

As shown in FIG. **5**, the engagement groove **21** of the striker **20** includes a lifting slope **44** that lifts the lock pin **23** in a direction facing away from the engagement groove **21** (direction of arrow Z**2** in FIG. **5**) when opening the lid **3**. Further, opposite sides on the distal end of the lock pin **23** form two chamfered portions **45***a* and **45***b*. When opened, the lid **3** is first slightly lifted by the urging member **4** and then manually opened. However, the urging member **4** may be omitted and the lid **3** may be opened only manually. Alternatively, the lid **3** may be opened by a push lifter.

Structure for Connecting Electric Components of Lock Device

Referring to FIG. **6**, a lock pin detection switch **46** is arranged in the movement path of the lock pin **23** to detect whether or not the lock pin **23** is located at a lifted position. The lock pin detection switch **46** may be, for example, a microswitch. The lock pin detection switch **46** is deactivated when the engagement pin **38** is free and not engaged with the lock pin **23**. The lock pin detection switch **46** is activated

when the lock pin **23** is lifted against the urging force of the urging member **25** by, for example, the lock arm **13** or the striker **20**. The lock pin detection switch **46** corresponds to a position detector.

The coupling position of the lock pin detection switch **46** is set so that the lock pin detection switch **46** is activated when the lock pin **23** is lifted by a predetermined amount. Thus, the lock pin detection switch **46** may be activated when the lock pin **23** is slightly lifted or when the lock pin **23** is lifted for a relatively large amount. In any case, the lock pin detection switch **46** detects the lock pin **23** when lifted.

Referring to FIG. **7**, the lock motor **31** is connected in parallel to a door lock motor **47**, which serves as a drive source for locking and unlocking a door. The lock pin detection switch **46** is connected to a wire connected to a motor circuit **48** of the lock motor **31**. The lock pin detection switch **46** is located, for example, between a connection point shared by the lock motor **31** and the power supply of the door lock motor **47**. The lock pin detection switch **46** is arranged in a power supply line connected to the lock motor **31** and detects whether the lock pin **23** has been moved from the unlock position to the lock position by the locking subject **3** or **9**. The lock pin detection switch **46** permits the supply of power to the lock motor **31** when movement to the lock position is detected. Thus, when current flows to the door lock motor **47** and the lock pin detection switch **46** is activated, the current also flows to the lock motor **31**. That is, the lock device **19** cooperates with the door locking action. The motor circuit **48** of the present example may be installed just by connecting the motor circuit **48** in parallel to a conventional door lock device (separate device). The door lock motor **47** corresponds to a second actuator, and the motor circuit **48** corresponds to an actuator circuit.

The operation of the lock device **19** in the present example will now be described with reference to FIGS. **8** to **11**. To simplify the drawings, in FIGS. **8** to **11**, the engagement pin **38** is shown engaged with the groove **42** of the lock pin **23**, and the engagement pin **38** is shown on the lock pin **23**.

Lid Unlock Operation

As shown in FIG. **8**, when the lid **3** is located at a close position, the lock pin **23** is engaged with the engagement groove **21** of the striker **20**, and the groove **42** of the lock pin **23** of the lock pin **23** is engaged with the engagement pin **38**. In this case, the lock pin **23** is fixed, and the lid **3** is locked. This prohibits opening of the lid **3**. Thus, the lid **3** cannot be opened.

When the lid **3** is locked, the striker **20** lifts the lock pin **23** by a predetermined amount to a lifted position. This activates the lock pin detection switch **46** and closes the motor circuit **48**. Thus, when unlocking the vehicle door, current flows in the unlock direction to the door lock motor **47**, and some of the current flows to the lock motor **31** so that the lock motor **31** generates rotation in the unlock direction. This moves the engagement pin **38** in the unlock direction (direction of arrow Y**2** in FIG. **8** facing away from the lock pin **23**) away from the groove **42** of the lock pin **23**, and the lock pin **23** becomes free. In this manner, the lid **3** is unlocked, and opening of the lid **3** is permitted.

When the lid **3** is manually opened, the lifting slope **44** of the striker **20** first pushes the chamfered portion **45***a* of the lock pin **23** and lifts the lock pin **23** in a removal direction (direction of arrow Z**2** in FIG. **8**). When the lid **3** fully opens, the urging force of the urging member **25** moves the lock pin **23** straight in the projection direction (direction of arrow Z**1** in FIG. **8**). This frees the lock pin **23** again, deactivates the lock pin detection switch **46**, and opens the motor circuit **48**. Thus, even when a door is locked or unlocked, current does not flow to the lock motor **31**, and the lock device **19** is not operated.

Charge Cable Lock Operation

As shown in FIG. **9**, when the charge cable **9** is unlocked, the lock pin **23** is located at the unlock position and is free. Thus, the lock pin detection switch **46** is deactivated. This closes the motor circuit **48**. Under this situation, when connecting the charge cable **9** to the inlet **6**, a lifting slope **50** at the distal end of the lock arm **13** lifts the chamfered portion **45***b* of the lock pin **23** in the removal direction (direction of arrow Z**2** in FIG. **9**). Thus, the lock pin **23** that is located at the lifted position activates the lock pin detection switch **46** and closes the motor circuit **48**.

When locking the vehicle door, current flows in the lock direction to the door lock motor **47**, and some of the current flows to the lock motor **31** so that the lock motor **31** generates rotation in the lock direction. Thus, the engagement pin **38** moves in the lock direction (direction of arrow Y**1** in FIG. **9**). In this case, even if the lock pin **23** excessively moves away from the lock arm **13**, while permitting movement of the rack **37** toward the lock side with the urging member **39**, the engagement pin **38** comes into contact with the guide slope **43** of the lock pin **23**.

Then, when the hook **14** of the lock arm **13** becomes hooked to the catch **17** of the inlet **6**, the engagement pin **38** moves to push the guide slope **43** and move the lock pin **23** in the projection direction (direction of arrow Z**1** in FIG. **9**). The lock pin **23** follows the movement of the lock arm **13** in the closing direction. Then, when the hook **14** is fully hooked to the catch **17**, the lock pin **23** comes into contact with an abutment surface **49** defined on the upper surface of the lock pin **23**. Further, the engagement pin **38** fixes the lock pin **23**. This locks the charge cable **9** so that the charge cable **9** cannot be removed from the inlet **6**.

Charge Cable Unlock Operation

As shown in FIG. **10**, when the charge cable **9** is locked, the lock pin **23** is held at a lifted position by the lock arm **13**. This activates the lock pin detection switch **46** and closes the motor circuit **48**. Thus, when unlocking the vehicle door, current flows in the unlock direction to the door lock motor **47**, and some of the current flows to the lock motor **31** so that the lock motor **31** generates rotation in the unlock direction. Thus, the engagement pin **38** moves in the unlock direction (direction of arrow Y**2** in FIG. **10**) away from the groove **42** of the lock pin **23**. This frees the lock pin **23**. In other words, the charge cable **9** is unlocked, and removal of the charge cable **9** is permitted.

Then, the power plug **11** is gripped to pivot the lock arm **13** to a release position so that the abutment surface **49** of the hook **14** lifts the lock pin **23** in the removal direction (direction of arrow Z**2** in FIG. **10**). Under this situation, the charge cable **9** is pulled out and removed from the inlet **6**. When the charge cable **9** is removed from the inlet **6**, the urging force of the urging member **25** pushes the lock pin **23** in the projection direction (direction of arrow Z**1** in FIG. **10**) and deactivates the lock pin detection switch **46** again.

Lid Lock Operation

As shown in FIG. **11**, when the lid **3** is unlocked, the lock pin **23** is located at the unlock position and free. This deactivates the lock pin detection switch **46** and closes the motor circuit **48**. Under this situation, when closing the lid **3**, the distal portion of the striker **20** lifts the chamfered portion **45***b* of the lock pin **23** in the removal direction (direction of arrow Z**2** in FIG. **11**). The lock pin **23** that is located at the lifted position activates the lock pin detection switch **46** and closes the motor circuit **48**. Then, when the lid **3** is fully closed, the

urging force of the urging member **25** moves the lock pin **23** in the projection direction (direction of arrow Z1 in FIG. **11**), and the lock pin **23** is engaged with the engagement groove **21** of the striker **20**.

Subsequently, when locking the vehicle door, current flows in the lock direction to the door lock motor **47**, and some of the current flows to the lock motor **31** so that the lock motor **31** generates rotation in the lock direction. Thus, the engagement pin **38** moves in the lock direction (direction of arrow Y1 in FIG. **11**) and engages the groove **42** of the lock pin **23** so that the lock pin **23** fixes the engagement pin **38**. In other words, the lid **3** is locked, and unauthorized opening of the lid **3** is prohibited.

The present embodiment has the advantages described below.

(1) The lock device **19** has a constantly locking urging structure, and the lock pin **23** lifted by the lock arm **13** or the striker **20** may be detected by the lock pin detection switch **46**. When the lifting of the lock pin **23** activates the lock pin detection switch **46**, the motor circuit **48** closes, and the current flowing to the door lock motor **47** when locking or unlocking the vehicle door drives the lock motor **31** so that the lock device **19** performs locking or unlocking. Thus, even though the locking and unlocking operations of the lock device **19** are performed in cooperation with the door locking, the lock device **19** is not operated unless the lid **3** or the charge cable **9** is connected to the power port **2**. Thus, the lock device **19** does not perform unnecessary operations. This increases the durability of the device.

(2) The lock motor **31** is connected parallel to the door lock motor **47**, and the current flowing to the door lock motor **47** when performing a door locking operation drives the lock motor **31**. Thus, the current flowing to the door lock motor **47** functions as a power supply for the lock motor **31**, and there is no need to prepare a separate power supply.

(3) The lock pin **23**, which is moved between the lock position and the unlock position by the lock motor, is a single component shared for locking the charge cable **9** and locking the lid **3**. Thus, there is no need for the charge cable **9** and the lid **3** to be provided with separate lock pins and lock motors. This simplifies the structure of the lock device **19**.

(4) When the lifting of the lock arm **13** or the striker **20** activates the lock pin detection switch **46**, the engagement pin **38** and the groove **42** are not properly engaged with each other, and the engagement pin **38** comes into contact with the guide slope **43**. Here, the urging member **39** permits movement of the rack **37** toward the locking side. Then, the urging force of the urging member **39** lowers the lock pin **23** so that the engagement pin **38** consequently engages with the groove **42**. In this manner, when the lock pin detection switch **46** detects that the lock pin **23** has been moved from the unlock position to the lock position by the locking subjects **3** and **9** and permits the supply of power to the lock motor **31**, the engagement pin **38** is permitted to move back against the urging force of the second urging member when the groove **42** of the lock pin **23** is not properly engaged with the engagement pin **38** and moved forward by the urging force of the urging member **39** when the groove **42** of the lock pin **23** is aligned with the engagement pin **38**. Thus, even when the lock pin detection switch **46** is activated and the engagement pin **38** and the groove **42** are not properly engaged with each other, the engagement pin **38** may consequently be engaged with the groove **42**, and switch the lock device **19** to a lock state.

(5) The chamfered portions **45***a* and **45***b* arranged on the distal end of the lock pin **23** allows for the lock pin **23** to be smoothly lifted by the lock arm **13** or the striker **20**.

It should be apparent to those skilled in the art that the present invention may be embodied in many other specific forms without departing from the spirit or scope of the invention. Particularly, it should be understood that the present invention may be embodied in the following forms.

The conditions for starting lid unlocking may be, for example, the operation of a predetermined button (switch) arranged in the vehicle or further pushing of the closed lid **3** when the electronic key system has accomplished ID verification. Further, the electronic key system is one example of wireless verification that performs ID verification (key verification) through wireless communication between a vehicle and an electronic key. For example, the electronic key system may be an operation-free key system that starts ID verification through narrow-band wireless communication (communication distance of several meters) in response to communication from a vehicle.

The condition for starting lid locking may be cooperation with door locking under the assumption that the lid **3** is closed. Further, the accomplishment of ID verification performed by the electronic key system may be included in the conditions for starting lid locking.

The condition for starting charge cable unlocking may be, for example, an unlocking operation performed on an operation switch dedicated for charge cable locking. Another condition for starting charge cable unlocking may be, for example, a plug connection detection signal, which is output from the plug connection detector **18** of the power plug **11**, being input to the vehicle body **1** and the vehicle door undergoing an unlock operation (door unlocking cooperation).

The condition for starting charge cable locking may be, for example, a locking operation performed on an operation switch dedicated for charge cable locking. The operation switch may be arranged in the power port **2** or in the vehicle. Another condition for starting charge cable locking may be, for example, a plug connection detection signal, which is output from the plug connection detector **18** of the power plug **11**, being input to the vehicle body **1** and the vehicle door undergoing an unlock operation (door locking cooperation).

The position detector does not have to be a contact switch and may be a contactless sensor.

The lifting position of the lock pin **23** that detects the lock pin detection switch **46** may be located at any location as long as the lifting of the lock pin **23** may be detected.

The motor circuit **48** may be independent from, for example, the circuit of the door lock motor **47**.

The actuator of the lock device may be, for example, a solenoid instead of a motor.

The plug connection detector **18** may be a switch or sensor arranged at the side of the inlet **6**. Further, the plug connection detector **18** may be of a contact type or a contactless type.

The lid **3** does not have to be opened by a torsion spring structure. For example, when the lid is further pushed from the close position, the lid **3** may be automatically opened by a push lifter.

During lid locking, the lock pin **23** may be engaged with a component other than the striker **20**.

The lock device **19** does not have to be coupled to the upper portion of the lid box **5** and may be coupled to the lid box **5** at other locations such as the side portion.

The lock device **19** may be fastened together with the inlet **6** when coupled to the lid box **5** or coupled separately to the lid box **5** regardless of the inlet **6**.

The lock device **19** may be switched to an unlock state by, for example, switching the trigger switch **22**.

One of locking and unlocking of the lock device may be performed manually, and the other one of locking and unlocking may be performed automatically.

The lock device **19** may be dedicated for charge cable locking or for lid locking. Further, in broad terms, the lock device **19** only needs to be arranged in the power port **2**.

The locking subject does not have to be the lid **3** or the charge cable **9** and may be any component related with the power port of a battery-powered vehicle.

The lock device **19** may have any structure as long as the urging member **25** constantly urges the lock pin **23** toward the locking side. For example, the lock member is not limited to a movable pin and may be a rotatable cylindrical pin member including a cutout portion. In this case, the lock arm **13** is fixed to a location free from the cutout portion, and the cutout portion allows for operation of the lock arm **13**. Further, the lock member may be a triangular plate pivoted between a lock position and an unlock position.

The lock device **19** may have a structure that shifts to a lock state by directly engaging the lock pin **23** with the housing (main body portion) of the power plug **11**.

The engaged portion of the lock member is not limited to a groove and may have any form such as a hole.

The lock device **19** does not have to be installed in a vehicle and may be applied to a different device or instrument.

The present examples and embodiments are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given herein, but may be modified within the scope and equivalence of the appended claims.

The invention claimed is:

1. A lock device for locking a locking subject, the lock device comprising:

a lock member that moves between a lock position where the lock member locks the locking subject and an unlock position where the lock member unlocks the locking subject;

a first urging member that constantly urges the lock member to the lock position;

a switching member that moves between a first position where the switch member fixes the lock member at the lock position and a second position where the switch member permits the lock member to unlock the locking subject;

a first actuator that drives the switching member; and

a position detector arranged in a power supply line connected to the first actuator, wherein the position detector detects whether or not the lock member has been moved from the unlock position to the lock position by the locking subject and permits power to be supplied to the first actuator when detecting the movement.

2. The lock device according to claim **1**, wherein the first actuator is connected in parallel to a second actuator that drives a device differing from the switch member.

3. The lock device according to claim **2**, wherein the position detector is arranged between the first actuator and a connection point shared by the first actuator, the second actuator, and a power supply.

4. The lock device according to claim **1**, wherein the locking subject is

one of a charge cable and a lid that opens and closes a power port, and

the lock member includes a distal portion engaged with one of the charge cable and the lid.

5. The lock device according to claim **1**, wherein

the switch member includes

an engagement member that is fitted to the lock member in a removable manner,

a support member that supports the engagement member, and

a second urging member arranged in the support member to apply urging force to the engagement member;

the lock member includes an engaged portion that is fitted with the engagement member of the switch member;

under a situation in which the position detector detects that the lock member has been moved from the unlock position to the lock position by the locking subject and permits the supply of power to the first actuator, the engagement member is permitted to move back against the urging force of the second urging member when the engaged portion of the lock member is not properly engaged with the engagement member, and the engagement member is moved forward by the urging force of the second urging member when the engaged portion of the lock member is aligned with the engagement member.

6. The lock member according to claim **2**, wherein the first actuator drives the switch member in cooperation with locking and unlocking of a door.

7. A lock system comprising:

a first locking subject including a first engagement portion;

a second locking subject including a second engagement portion; and

a lock device including

a lock member that moves between a lock position where the lock member locks one of the first and second locking subjects and an unlock position where the lock member unlocks the one of the first and second locking subjects, wherein the lock member includes an engaged portion selectively engaged with the first and second engagement portions of the first and second locking subjects,

a first urging member that constantly urges the lock member to the lock position,

a switching member that moves between a first position where the switch member fixes the lock member at the lock position and a second position where the switch member permits the lock member to unlock the one of the first and second locking subjects;

a first actuator that drives the switching member; and

a position detector arranged in a power supply line connected to the first actuator, wherein the position detector detects whether or not the lock member has been moved from the unlock position to the lock position by the one of the first and second locking subjects and permits the supply of power to the first actuator when detecting the movement.

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